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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003905117 for a patent by COOPERATIVE RESEARCH CENTRE FOR AUSTRALIAN WEED MANAGEMENT as filed on 19 September 2003.

I further certify that the name of the applicant has been amended to ADELAIDE RESEARCH AND INNOVATION PTY LTD pursuant to the provisions of Section 104 of the Patents Act 1990.



WITNESS my hand this
Twenty-ninth day of September 2004

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ORIGINAL

PROVISIONAL SPECIFICATION FOR AN INVENTION ENTITLED:

Invention Title: An apparatus and method for furrow opening using a disc
Name of Applicant: Cooperative Research Centre for Australian Weed
Management
Address for Service: LESICAR PERRIN, 49 Wright Street, Adelaide, SA 5000

The invention is described in the following statement:

An apparatus and method for furrow opening using a disc.

BACKGROUND OF THE INVENTION

There are various forms of furrow openers used in agriculture to sow seed and deposit fertilizers into the soil. Traditionally hoe-type implements have been
5 used in sowing crops that used to be drawn behind animals and more recently behind motorised machinery, and form a furrow by drawing a shovel or knife through the soil.

Other openers incorporate a concave or flat disc that is pulled behind
10 machinery at an angle to the direction of travel. The disc of such an opener bites into the soil and produces a furrow by dragging the soil along in front of the disc. Seed is then deposited in the furrow and a subsequent disc covers the seed with soil.

All these types of furrow openers cause substantial disturbance to the soil surface, which can increase the likelihood of erosion by wind and water. The soil disturbance and risk of erosion poses significant problems in arid countries such as
15 Australia where the soils of the cropping and cereal belt are extremely shallow.

In an attempt to alleviate these potential problems various reduced tillage techniques have been developed. Furrow opening discs have gained popularity, as there is limited soil disturbance in the process of cutting a furrow in preparation for sowing. Consequently a number of double and single disc openers have been
20 developed in recent years.

Double disc openers, which have the axis of rotation at a very small angle to the direction of travel, have been developed to minimise tillage. These openers produce a furrow by cutting a groove in the soil by way of two paired discs. Single disc openers by contrast require the disc to be set at a larger angle to the direction of
25 travel thereby increasing the width of the groove produced and consequently creating a viable furrow. The angle of the single disc however increases the power required to pull such implements behind machinery.

Double disc openers are therefore seen to have distinct advantages over the single disc opener since less power is required in producing a viable furrow and soil
30 forces are parallel to the direction of travel.. Nevertheless, the conventional double disc opener has a number of limitations. One of these is that the floor of the furrow is compacted during seeding and often hampers root elongation of the crop seedlings.

The lack of tillage below the seed zone is believed to be one of the reasons why fungal diseases such as rhizoctonia occur. Another limitation with the conventional double disc opener is that during operation straw is often pushed into the seed furrow. This is known as hair pinning and can result in the subsequently sown crop being affected by phytotoxins. Phytotoxins are compounds produced through the process of plant decomposition that inhibit the growth of other plants. Hair pinning can also result in incomplete furrow closure that may further decrease the fecundity of the crop. Yet another disadvantage of conventional double disc openers is the placement of fertilizer in close proximity to seed without any mixing with soil resulting in concentrations that are toxic to crop seedlings. Yet a further disadvantage of conventional double disc openers is that the discs form a wedge at the point of entry into the soil and large amount of downward force is necessary to engage the opener into the soil.

The potential of straw and plant material to block the disc apparatus is also a significant problem in the operation of conventional furrow openers. A blockage can prevent the disc rotating thereby hampering the production of a viable seed furrow, and can furthermore increase the power required to pull the disc apparatus through the soil and cause considerable inconvenience to the operator.

It is an object of the present invention to provide an apparatus and method for furrow opening using a furrow opener that overcomes at least some of the aforementioned problems or provides the public with a useful alternative.

It is a further object of the present invention to provide a furrow opener utilising a double disc arrangement that further performs tillage below the seed zone.

It is yet a further object of the present invention to provide for a furrow opener that reduces the likelihood of hair pinning.

It is a further object of the present invention to provide a furrow opener utilising a double disc arrangement that further performs mixing of soil and fertilizer below the seed zone.

It is still a further object of the present invention to provide a furrow opener utilising a double disc arrangement that will penetrate hard soil without excessive vertical force.

SUMMARY OF THE INVENTION

The present invention relates to an apparatus and method for furrow opening using a disc.

5 Therefore in one form of the invention there is proposed an apparatus for furrow opening including:
a first toothed disc; and
a second analogous disc operatively coupled to said first disc.

Preferable said first and second discs are rotatably mounted to said apparatus.

10 Preferably each said disc includes a central circular plate and a plurality of teeth extending symmetrically and circumferentially from each said disc.

Preferably said discs are mounted so as to upwardly and rearwardly diverge from each other.

15 In preference said teeth of each disc extend at an angle to said disc plate. Preferably the two discs are mounted so that their teeth are parallel to each other with the plane of the plate of each disc thereby being mounted at an angle to each other.

Preferably each said notched disc forms a frustum of a cone, with a substantially concave side and a substantially convex side.

20 Preferably the teeth on the periphery of the first disk abut the teeth on the periphery of the second disk at a lower vertical position approximating the soil entry point.

Preferably the first and second discs of a pair are orientated so that the concave surface is facing outward.

25 Preferably a scraping assembly is associated with the opening disc apparatus to dislodge any soil or straw that adheres to the said first and second discs during operation.

30 In a further form of the invention there is proposed a method for creating a seed furrow in soil using at least one notched opening disc attached to an agricultural implement, said method including the steps of:

drawing the agricultural implement across the surface of the soil, whereby the said opening disc penetrates the surface of the soil

allowing said disc to rotate about an axis which is substantially perpendicular to the direct of travel of the said agricultural implement, thereby creating a furrow.

5 In preference two analogous discs are used in combination to create each furrow.

In preference more than one pair of discs are attached to each agricultural implement.

In preference the depth that the discs penetrate the soil can be adjusted.

10 BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification together with the description, serve to explain the advantages and principles of the invention. In the drawings,

15 Figure 1 is a perspective view of a furrow opening disc assembly of the present invention;

Figure 2a is a side view of furrow opening disc assembly of Figure 1;

Figure 2b is a cross-sectional view between points A and B of the furrow opening disc assembly of Figure 2;

20 Figure 3 is a side view of the furrow opening disc assembly of Figure 1 illustrating the effect that the notched teeth have on the floor of the furrow;

Figure 4 is a schematic cross sectional view of a soil profile through which a furrow opening disc assembly has passed; and

25 Figure 5 is a perspective view of a furrow opening disc assembly of the present invention illustrating the contoured ends and sharp chamfered edges of the teeth.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description of the invention refers to the accompanying drawings. Although the description includes exemplary embodiments, other

embodiments are possible, and changes may be made to the embodiments described without departing from the spirit and scope of the invention. Wherever possible, the same reference numbers will be used throughout the drawings and the following description to refer to the same and like parts.

5 Referring to the drawings for a more detailed description, a furrow opening disc assembly 10 is illustrated in Figure 1, demonstrating by way of example one arrangement in which the principles of the present invention may be employed. As illustrated the present invention of a furrow opening disc assembly 10 includes a pair of opposing disc blades or plates 12 with outer symmetrical and peripheral teeth 14, 10 rotatably mounted on a bearing cap 16, a bearing housing 18 (as illustrated in Figure 3) a seed and fertiliser boot 20 and a mounting bracket 22.

The disc blades 12 are secured to the bearing cap 16 by a plurality of rivets or bolts 24. The blades 12 are able to rotate in relation to the seed boot 20, in a manner well known in the art. The seed boot 20 incorporates a duct 26 through 15 which seed and fertiliser can be deposited separately into the furrow cut by the disc opening blades 12. The seed boot 20 illustrated in Figure 1 incorporates an open rectangular funnel shaped duct 26 to accommodate a fertilizer delivery tube towards the front of the duct and a seed delivery tube at the rear. However it should be understood by the reader that the invention is not limited to such a configuration. A 20 tube or pipe could alternatively be used to deposit the seed and fertiliser into the furrow.

Turning now to Figures 2a and 2b there is illustrated a side view and a cross sectional view of the furrow opening disc assembly 10. Figure 2b shows the cross-section between point A and point B of Figure 2a. As illustrated in Figure 2b the 25 blades 12 of the disc assembly 10 are positioned at an angle from each other to form a V-shaped cutting point 28. The outwardly extending teeth 14 of the analogous disc blades 12 are parallel to each other and abut 30 each other at a lower vertical point 32 than the axis of rotation 34 of the disc blades 12, as illustrated in Figures 2a and 2b. As further illustrated in Figure 2b the disc blades 12 diverge upwardly from each 30 other in the vertical plane. It is to be understood that the teeth of opposing discs do not always have to abut fully against each other and can partially abut, generally at the tip of the teeth.

In the present example the point 32 where the teeth 14 of the two blades 12 fully abut 30 is towards the leading edge 36 of the disc assembly 10, as illustrated in

Figure 2a. However the skilled addressee should understand that the present invention is not limited to such a configuration. The point 32 where the teeth 14 fully abut 30 could alternatively be at a lower or higher vertical position of the disc assembly 10 or any other configuration sufficient to achieve the cutting of a furrow.

5 By having point 32 located towards the leading edge 36 of the disc assembly 10 as is illustrated in Figure 3, rather than towards the trailing edge 38, the faces of the teeth 14 are exactly mated as they enter the soil. This means that minimum down-pressure is required to cut and compact a seed furrow. Furthermore the angle of the disc blades 12, which diverge upwardly away from each other in a vertical
10 plane towards the trailing edge 38 as previously illustrated in Figure 2b, means that the furrow is progressively wedged apart. This allows the seed and fertilizer to be deposited into a furrow that is wider than that which was cut by the leading edge 36 of the disc assembly 10.

The disc assembly 10 can be fitted to an agricultural implement (not shown)
15 used in the production of furrows for receiving grain and fertiliser by means of the mounting bracket 22. As the agricultural implement is drawn across the soil surface the disc assembly 10 penetrates the surface of the soil 40 as illustrated in Figure 3. The partially submerged disc blades 12 rotate about the axis 34 that is substantially perpendicular to the direction of travel 44 of the agricultural implement thereby
20 creating a furrow 46. It should be understood by the reader that a plurality of disc assemblies 10 could be fitted to a single agricultural implement thereby forming adjacent rows. Increasing the distance between the disc assemblies 10 can alter the distance between the furrows 46.

A further advantage of the present invention over conventional double disc
25 openers is that the disc blades 12 perform some tillage below the seed zone. This is illustrated in Figure 4 where the floor 48 of the furrow 46 is tilled 50 by the teeth 14 of the disc blades 12. This tillage 50 below the seed zone helps to control fungal disease such as rhizoctonia that can occur because of plough tillage with conventional double disc openers.

30 As discussed earlier a limitation with conventional double disc openers is that because of the circular shape of the discs, any straw or stubble that is caught in front of the disc is forced down into the furrow and left behind when the disc opener advances forward. Commonly referred to as hair pinning it can cause damage through phytotoxin effects to the crop that is subsequently sown. Phytotoxins are

chemicals that are released from plants as they decompose and can severely effect the growth of other plants in the vicinity.

The configuration of the present invention overcomes the problems of hair pinning as well as dealing with the problem of blockage of the disc assembly 10 by plant matter. As illustrated in Figure 5 the teeth 14 of the discs embodying the preset invention are constructed with contoured or arcuate ends 50 to deflect straw and plant material thereby reducing 'hair pinning' in the seed furrow. Furthermore the teeth 14 of the present invention are constructed with sharp chamfered edges 52 to cut any plant material as it travels away from the contoured ends 50 of the teeth 14. Any straw that is still uncut is carried out of the seed furrow by the teeth 14 and cannot therefore damage the crop though phytotoxin effects.

The configuration of the disc assembly 10 means that the teeth 14 grip plant material and break it through tension as the teeth 14 of the paired discs 12 diverge. The teeth 14 diverge as they rotate around axis 34 from a leading edge 36 position to a trailing edge 38 position. As the reader will now appreciate the configuration of the disc assembly 10 reduces the likelihood of the hair pinning and the resultant phytotoxic effects on the crop subsequently sown.

In a further embodiment of the present invention a scraping assembly is associated with the opening disc apparatus 10 to dislodge any soil that adheres to the discs 12 during operation. "Sticky soil", as they are commonly referred to, can restrict the blades of the disc assembly from rotating and can generally impede the effectiveness of the furrow cutting implement. This is particularly relevant where the soil water content is greater than 30% w/v moisture.

Thus in summary, the tips of the fingers or teeth of the disc of the present invention deflect straw instead of pushing it further into the soil. The edges of the fingers slice the straw as it is deflected away from the tips. Uncut straw is wedged between fingers and broken in tension by the divergence of the discs. Any further uncut straw is removed from the furrow by the fingers, cleared by the scraper, and deposited back on the soil surface.

Typical dimensions of the teeth are a height of some 60 mm, a width at their base of 45 mm and some 10 mm across their front edge.

The reader should now be aware that the present invention provides a novel furrow opening disc assembly, which is able to be used in conjunction with

conventional agricultural machinery. The configuration of the disc assembly of the present invention overcomes some of the limitations of currently available double disc openers. The teeth of the disc assembly provide tillage below the seed zone and their configuration reduces the likelihood of hair pinning of plant material within the furrow. Consequently reducing fungal disease and phytotoxic effects will increase the fecundity of the crop.

Further advantages and improvements may very well be made to the present invention without deviating from its scope. Although the invention has been shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope and spirit of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

In the summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in the sense of "including", i.e. the features specified may be associated with further features in various embodiments of the invention.

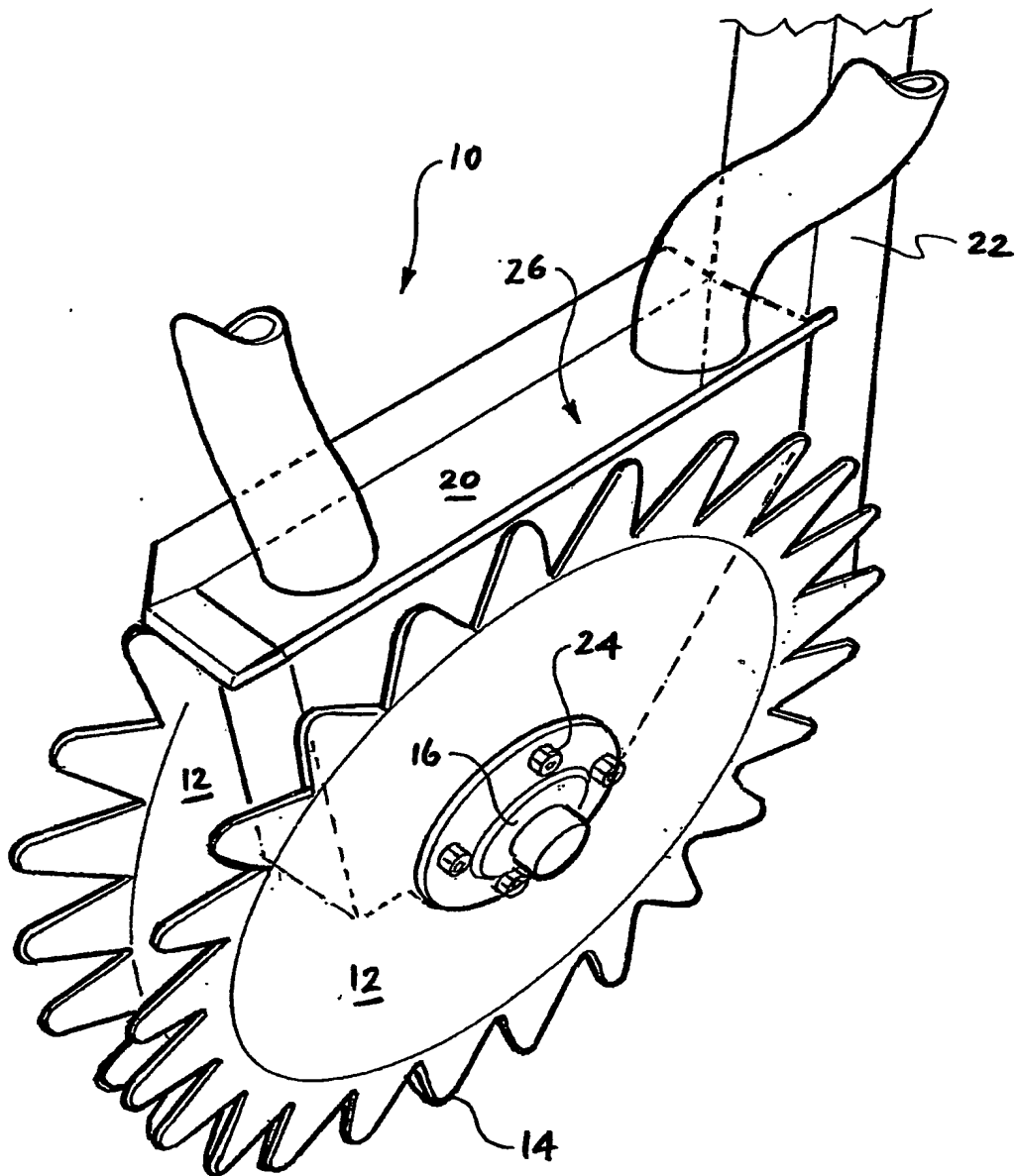


Fig 1

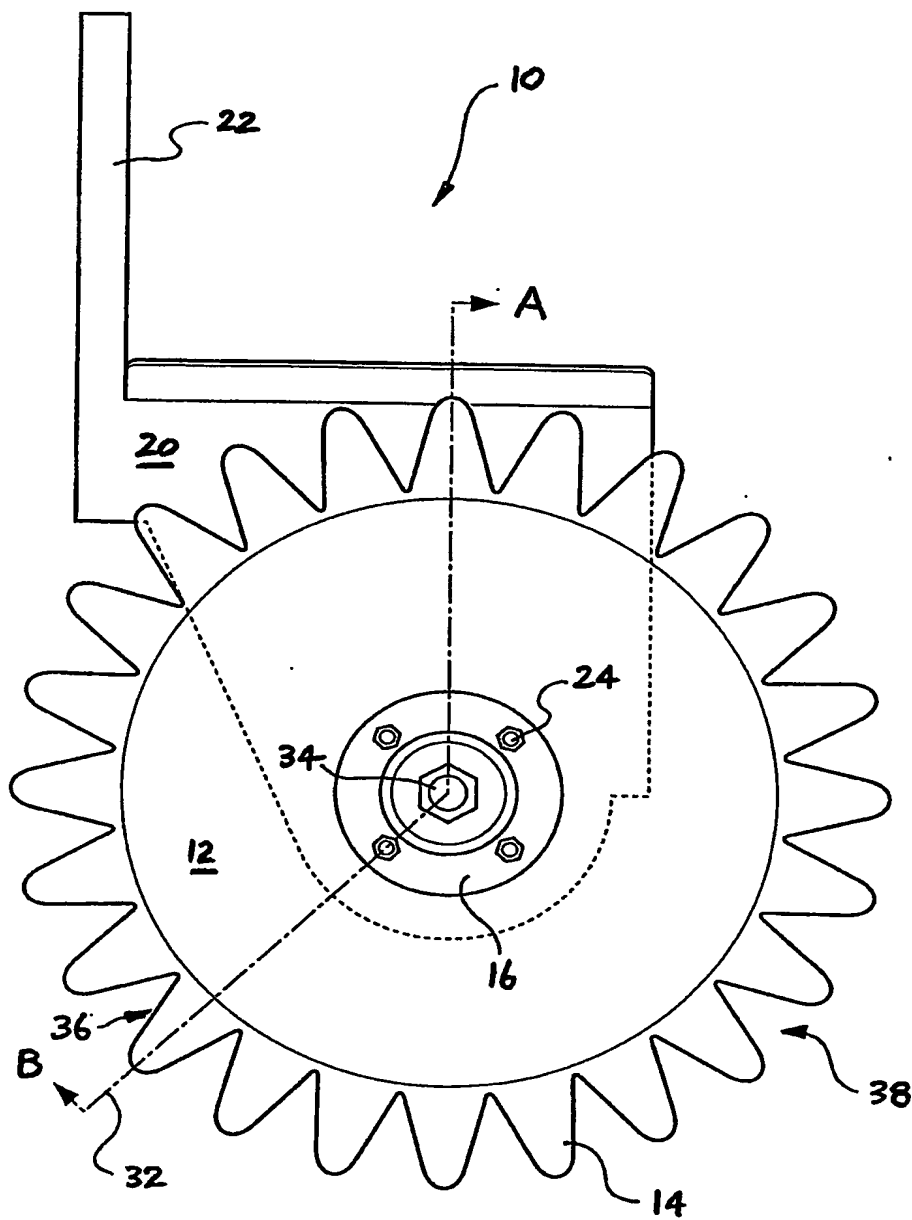


Fig 2a

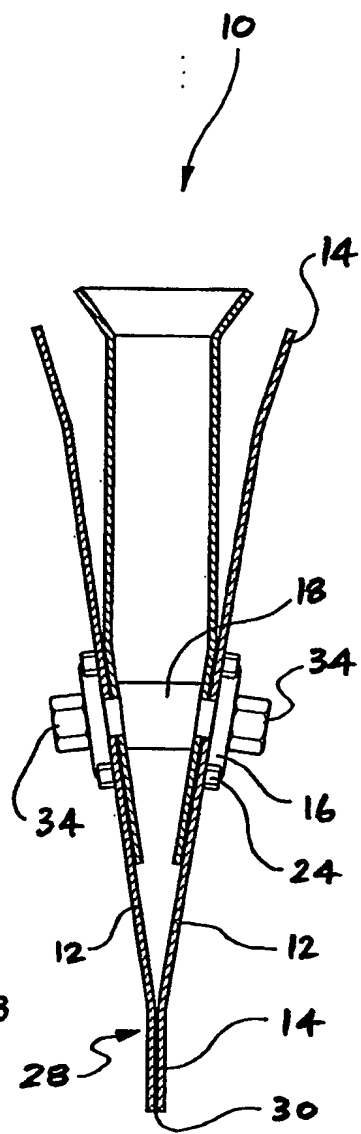
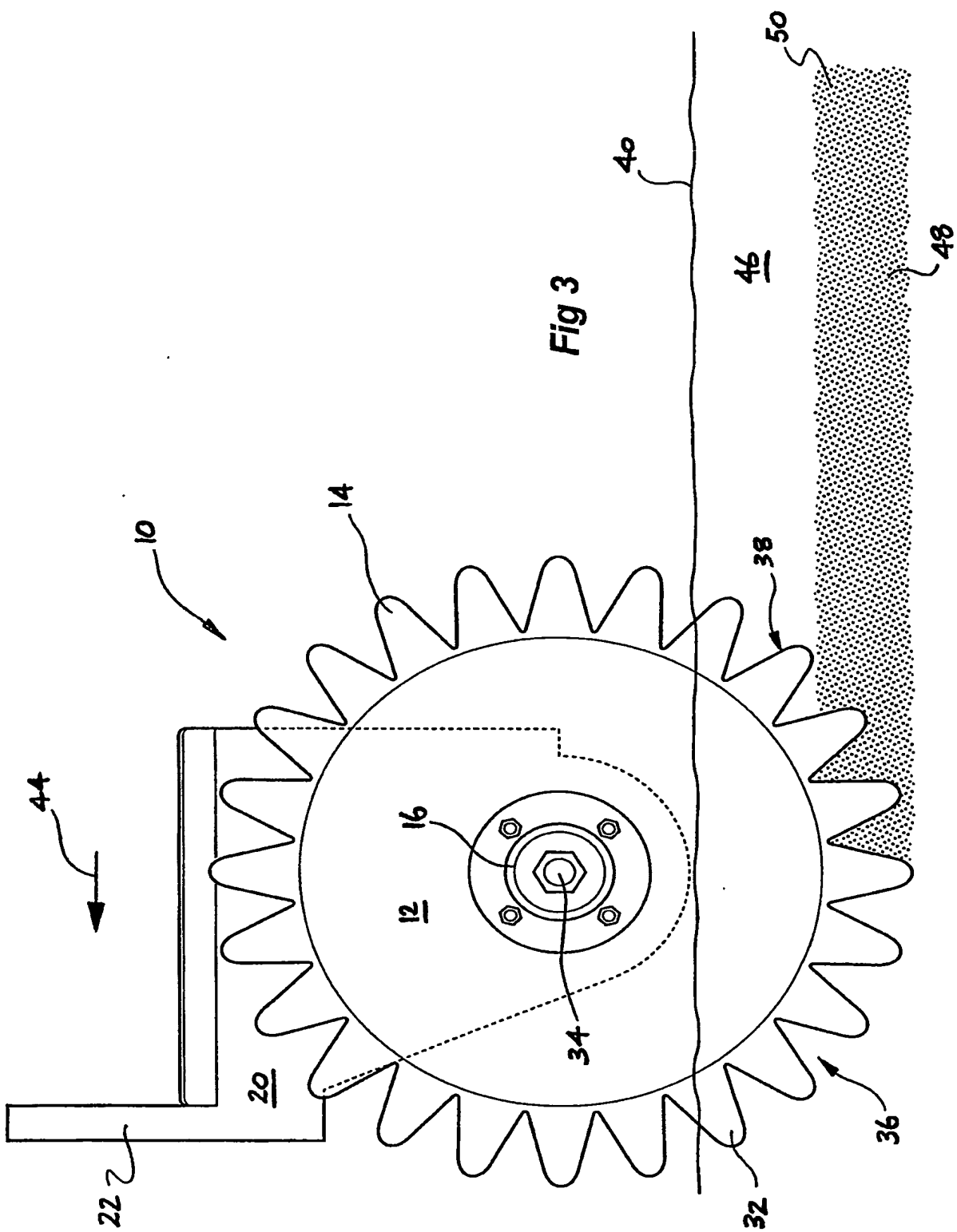


Fig 2b



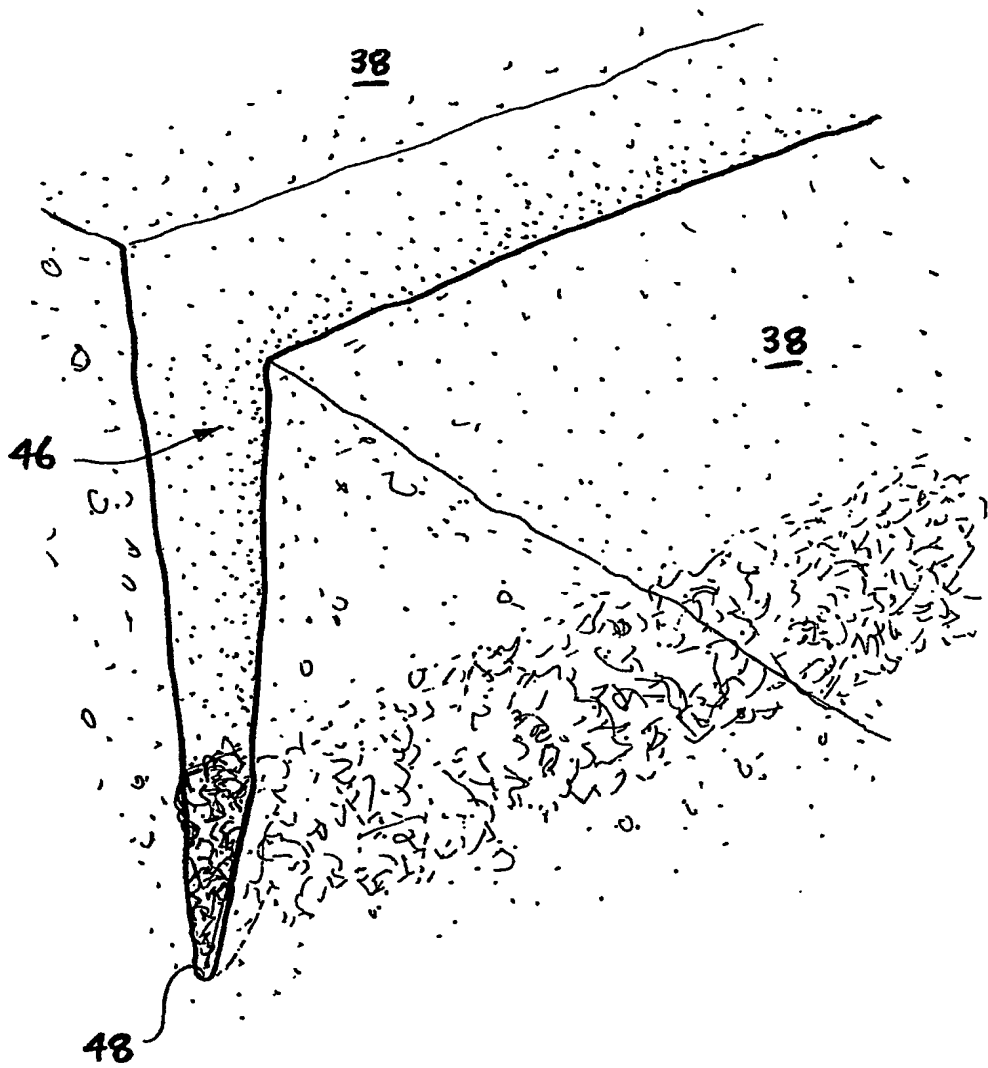


Fig 4

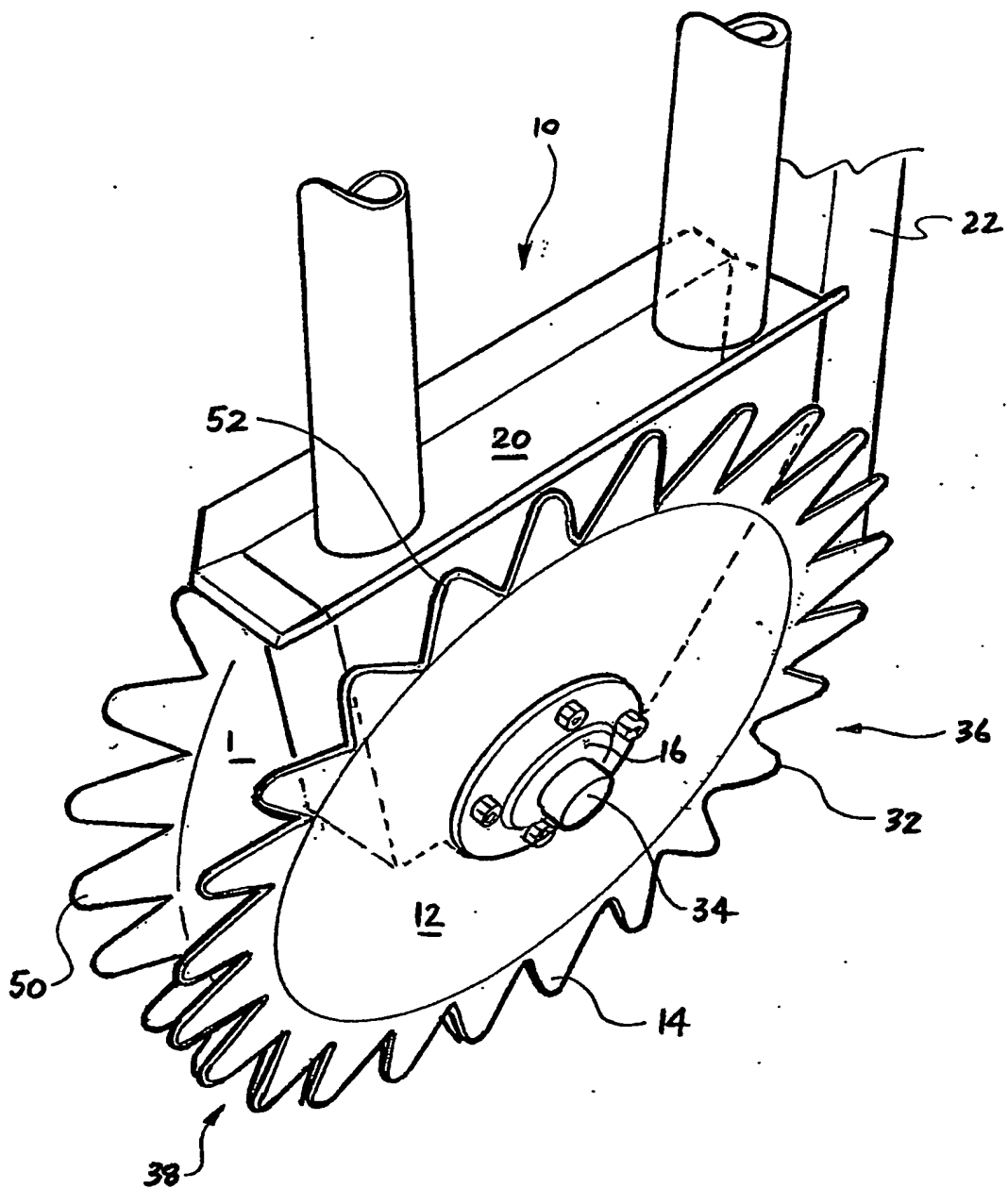


Fig 5